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(58) Field of search
C3N

(54) Method of manufacturing fireproofed chipboards and shaped-members

(57) A method of manufacturing fireproofed chipboards and wood chip shaped-members, by admixing one or more fireproofing substances, wood chips and adhesive resin, distributing the preglued wood chips and pressing same, wherein the adhesive resin is made strongly acidic with the admixture of one or more fireproofing substances and the preglued wood chips are mixed with one or more fillers which prevent combustion prior to fabrication so that the adhesive resin wood chip mix is at least substantially neutralized by said fillers.

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SPECIFICATION

Method of manufacturing fireproofed chipboards and shaped-members

The invention relates to a method of manufacturing fireproofed chipboards and shaped members.

The use of non-fireproofed wood chip panels and wood chip shaped-members in the building industry is limited. Even the use of slightly fireproofed chipboards is severely restricted because here too the fire resistance properties are still inadequate. Attempts have therefore been made to improve the fire resistance performance of wood chip panels and wood chip shaped-members, but hitherto the achievement of improved flame-resistance for boards or panels and shaped members has been at the expense of a substantial loss with regard to other properties.

Previously proposed methods for producing fireproofed wood chipboards have involved pretreating the wood components with fireproofing agents. In these methods, the wood chips are impregnated under pressure or without pressure in costly processes which are technically involved and expensive, and are then dried to a moisture content as is required for manufacturing the chipboards or panels. Other methods involve the production of the flameproofing agent in a preliminary operation, for example using boron minerals such as colemanite and inorganic acids. The chips are pretreated with the agent, dried and used together with gypsum produced for the manufacture of fireproofed panels or boards. Fly ash or vermiculite may also be added for example to the wood chips. It has also been proposed to use inorganic binding agents such as for example cement or water glass, instead of organic binding agents such as glue or adhesive resins. It has also been proposed to replace the wood chip component substantially by inorganic fillers, but this results in considerable loss of strength, in particular in the outer or surface layers. When using magnesite mixtures as the binding agents (see, e.g. German Patent Specification No. 2 550 857), it has been found that, after the pressing operation and after having been stored for several days, the boards or panels have marked hygroscopicity. Difficulties also arise with regard to further treatment and improvement of fireproofed chipboard panels of that kind. The direct formation of decorative coatings on such chipboards or panels, with for example melamine resin-impregnated papers, is not possible. Special tools are required for further treatment, and special suction removal devices must be installed for cutting as dust of relatively heavy specific weight is produced when using such materials formed with inorganic binding agents such as for example cement.

It has also been proposed to mix conventional adhesive resins with fireproofing substances while substantially maintaining the proportion of wood, but as already mentioned, this only results in inadequate fireproofing which severely limits the use of such products.

Another serious problem is that the adhesive resins which are preferably used in this context have a tendency to premature hardening after the addition of known fireproofing substances, in particular boric acid.

We have now found it possible to provide a method of manufacturing wood chipboards and wood chip shaped-members which exhibit very good fireproof properties in conjunction with substantially maintaining other good properties of the wood chip materials, so that such wood chipboards and wood chip shaped-members can be further processed and improved without difficulty, just like non-fireproofed boards and shaped members.

The invention provides a method of manufacturing fireproofed chipboards and wood chip shaped-members wherein the adhesive resin is made strongly acidic with the admixture of one or more fireproofing substances and the preglued wood chips are mixed with the combustion-preventing fillers prior to fabrication and the binding agent wood chip mix is neutralized with said fillers to such a degree that the binding agent hardens in the usual manner.

The method according to the inventon gives a number of surprising effects. Thus, it has surprisingly been found that the operation of mixing the fireproofing substances with the glue or adhesive resin gives rise to fewer difficulties when the mixture is made very strongly acidic, for example with a pH of the order of about 2 or lower. In addition, the mixture which has been made strongly acidic has an high capacity for impregnation with regard to the wood chips. In that way, at least a part of the fireproofing substance may be easily introduced into the material. Now, in accordance with the invention, a further part of the fireproofing substances and combustion-preventing substances is introduced by admixing the fillers with the already preglued wood chips. The wood chips may be themselves obtained in an easy and, in particular, also very homogenous form, primarily because pregluing the wood chips means that the fillers which are usually supplied in powder form do not separate into the components of the mixture again, particularly in the scattering operation, which would result in a final product which was not homogenous. Thus, in the method of the invention there is very little likelihood of the filler mixture breaking down into its components. This gives a final product which has a high degree of fireproofing, while substantially retaining the usual properties of a wood chip product, in conjunction with the

strength and processing capabilities which are normally achieved using conventional adhesive resins for making chipboards or panels. In this respect, the addition of the combustion-preventing filler powder at the same time also make it possible very substantially to neutralize the binding agent wood chip mix which is initially made strongly acidic by the binding agent mixture, in the manner that is required for further treatment or processing of the products. There is no need for an expensive operation of pretreating the chips. The manufacturing operation may be carried out with only slight alterations to a conventional chipboard production installation. In spite of the filler component which gives very good fireproofing and which consequently results in a reduced amount of the wood chip component in the end product, it has surprisingly been found that the method of the invention requires substantially only the same amount of binding agent as for an unproofed board or panel, which leads to the conclusion that there is a certain extender effect in respect of the salts and additive substances.

In spite of the filler component, products prepared in accordance with the invention exhibit a surprisingly high strength and, on the ther hand, a very low density of fumes produced upon combustion thereof.

By using conventional binding agents in spite of the excellent fireproofing effect, not only are the properties of non-fireproofed wood chipboards or panels retained virtually in their entirety, but some properties are even considerably improved, in paticular the water absorption and swelling properties as well as the development of smoke. Thus, in panels produced in accordance with the invention, the 2-hour swelling properties were about 2% while the 24-hour swelling properties were 3 to 4%. Fume densities were about 10%. Fire tests which have been carried out have shown that substantial residual strength values are retained. After a fire test for a period of 20 minutes at 700°C, the bending strength of testpieces only fell to about one-third of the bending strength of the board in its rough or crude state.

The boards or panels produced in accordance with the method of the invention, with their high strength values, in particular of the outer or surface layers, may be subsequently improved or treated without difficulty, just like non-fireproofed chipboards or panels. For example, they may be veneered or coated with resin-impregnated papers. Processing of coated or veneered panels or boards can be carried out with conventional tools for processing chipboard. Special suction removal devices in processing devices are not required when handling the fireproofed chipboards.

The boards or panels produced in accordance with this method may be manufactured under conventional chipboard pressing conditions, and the usual pressing temperatures. Both single-ply and multi-ply chipboards or panels, as well as corresponding shaped members, may be easily produced by this method.

Melamine formaldehyde condensation products, urea formaldehyde condensation products or melamine urea phenol formaldehyde condensation products or mixtures thereof may be used as the adhesive resin, that is to say, as the binder. Optional additives include, for example, up to 25% of isocyanates such as diphenylmethane-4,4'-diisocyanate. In this respect, hardeners are desirably added to amino resins, for example the addition of 2 to 10% ammonium chloride, ammonium sulphate or diammonium peroxydisulphate in the form of a 10–30% aqueous solution is convenient. Phosphoric acid, boric acid and/or aluminium sulphate are advantageously added as the fireproofing substances which result in the resin fireproofing substance mixture being strongly acidic. Phosphoric acid is particularly preferred for making the mixture very strongly acidic.

The weight ratio of adhesive resin to, for example, phosphoric acid may be varied within relatively wide limits and is generally in the range of from 4 : 1 to 1 : 4, preferably 1 : 2 to 2 : 1.

The concentration of the adhesive resin components and the fireproofing substances is preferably such that, with an initial moisture content of the chips being about 4%, the moisture content of the glued chip mixture to which combustion-preventing fillers are added is about 10 to 23%. In this respect, the concentration of adhesive components in the solids content may vary from 55 to 80%.

Inorganic fillers to prevent combustion, that have been found advantageous, are for example, aluminium oxide hydrate, aluminium sulphate, dolomite, kaolin, kieselguhr and barytes as well as mixtures of such substances, in proportions by weight in each case of about 10 to about 50%

A strongly fireproofed chipboard or panel produced substantially as described above comprises approximately one third wood chips, one third binding agent, fireproofing substance mixture and the inorganic, combustion-preventing fillers.

The following non-limiting Examples serve to illustrate the invention:–

Example 1:

1200 g of wood chips, being 0.2 to 0.6 mm in thickness and 1 to 15 mm in length, with a residual moisture content of 4 to 5%, are mixed with 390 g of melamine resin (60%), with a melamine : formaldehyde molar ratio like 1 : 2.0, 8 g of ammonium chloride (25% aqueous solution), and 410 g of phosphoric acid (60%).

A mixture comprising 500g of aluminium

sulphate, 130 g of boric acid, 340 g of kieselguhr and 360 g of barytes is then applied to the preglued chips and further mixed.

The chip mixture is then scattered to form a chip layer and pressed in a box or plate press.

The panel or board produced is ground and then coated with melamine resin-impregnated decorative papers.

Example 2:

1200 g of wood chips, being from 0.2 to 0.6 mm in thickness and from 1 to 35 mm in length, with a moisture content of 4 to 5%, are mixed with a mixture comprising 600 g of melamine resin (60%), with a melamine : formaldehyde molar ratio of 1 : 1.6, 60 g of diammonium peroxydisulphate (10%), 400 g of phosphoric acid (60%) and 130 g of boric acid.

500 g of aluminium sulphate, 340 g of kieselguhr and 360 g of barytes are then added.

The chip mixture is scattered to form a layer and pressed in a box or plate press. The wood chip panel, after the grinding operation, is coated with a 60% melamine resin solution, lined with a wood veneer, and pressed in a box or plate press. The chip board or panel when veneered in that way is removed in the hot condition from the mould, the veneer is slightly ground, and it is then treated with a fireproofing lacquer.

Example 3:

1200 g of wood chips, of a thickness of 0.2 to 0.6 mm and a length of from 1 to 15 mm, with a moisture content of 4 to 5%, are mixed with 800 g of melamine urea resin (60%), with a melamine : urea molar ratio of 1 : 1 and a melamine/urea : formaldehyde molar ratio of 1 : 1.4, 400 g of phosphoric acid (60%) and 80 g of boric acid.

500 g of kieselguhr and 700 g of barytes are then applied to the preglued chips and further mixed until uniform distribution has occured.

The chips are subjected to further processing, as described above in Example 1.

Example 4:

1200 g of wood chips, being 0.2 to 0.6 mm in thickness and 1 to 15 mm in length, with a moisture content of 4 to 5%, are mixed with 400 g of melamine resin, with a melamine : formaldehyde molar ratio of 1 : 1.4, to which was added 50 g of 30% ammonium sulphate, as a hardener, together with 800g of phosphoric acid (60%) and 250 g of boric acid; 250 g of aluminium oxide hydrate, 300 g of kieselguhr and 700 g of barytes are then added, and further mixing is effected.

The chips when treated in that way were subjected to further processing, as described above in Example 1.

Example 5:

1200 g of wood chips, 0.4 to 0.8 mm in thickness and 5 to 25 mm in length, with a moisture content of 4 to 5%, are treated with a mixture comprising 600 g of melamine resin (60%), with a melamine : formaldehyde molar ratio of 1 : 1.6, 150 g of phosphoric acid (60%) and 200 g of boric acid. A mixture comprising 400 g of barytes, 400 g of kaolin and 400 g of kieselguhr is then applied to the preglued chips, and further mixing is effected. The chips are used for the centre ply or layer.

Example 6:

1200 g of wood chips, 0.2 to 0.6 mm in thickness and 2 to 8 mm in length, with a moisture content of about 5%, are coated with a mixture comprising 600 g of melamine resin (60%), melamine : formaldehyde molar ratio like 1 : 1.6, 100 g of boric acid, 400 g of phosphoric acid (60%) and 200 g of aluminium sulphate; further mixing is then effected with 500 g of kaolin and 500 g of kieselguhr. The chips are used for the cover or surface layer.

Example 7:

1200 g of wood chips, 0.2 to 0.6 mm in thickness, 2 to 8 mm in length and with a moisture content of about 5%, are treated with a mixture comprising 400 g of melamine resin (60%), with a melamine : formaldehyde molar ratio of 1 : 1.8, 400 g of phosphoric acid (60%) and 200 g of aluminium sulphate and further mixing is then effected, using 500 g of barytes, 500 g of kaolin and 400 g of boric acid.

Further processing of the treated wood chips is effected as described in Example 1.

Example 8:

1200 g of wood chips, 0.2 to 0.6 mm in thickness and 2 to 15 mm in length, with a moisture content of 4 to 5%, are mixed with 400 g of melamine resin (60%), with a melamine : formaldehyde molar ratio like 1 : 1.8, 100 g of phosphoric acid (60%) and 150 g of boric acid; further mixing is then effected using 400 g of barytes and 400 g of aluminium oxide hydrate.

The chips are processed as described above in Example 1.

Example 9:

1200 g of wood chips, 0.2 to 0.6 mm in thickness and 1 to 15 mm in length, with a moisture content of 4 to 5%, are treated with a mixture comprising 200 g of melamine resin (60%), with a melamine : formaldehyde molar ratio of 1 : 2.0, 200 g of phosphoric acid and 200 g of aluminium sulphate.

The preglued chip mix is then further mixed with 120 g of boric acid, 120 g of kieselguhr,

40 g of kaolin and 45 g of dolomite. The chips are subjected to further processing as described in Example 1.

Example 10:

1200 g of wood chips, 0.2 to 0.6 mm in thickness, and 1 to 15 mm in length, with a moisture content of 4 to 5%, are mixed with 400 g of melamine resin (60%), with the melamine : formaldehyde molar ratio being 1 : 1.6, 200 g of boric acid and 400 g of phosphoric acid; a mixture comprising 400 g of barytes, 400 g of aluminium sulphate and 400 g of dolomite is then added, and further mixing is effected. The chips when treated in that way are subjected to further processing as described in Example.

Example 11:

1200 g of wood chips, 0.2 to 0.6 mm in thickness and 1 to 15 mm in length, with a moisture content of about 4%, are treated with a mixture comprising 400 g of melamine urea formaldehyde resin, 60 g of diphenylmethane 4,4'-diisocyanate, 460 g of phosphoric acid (60%), 40 g of diammonium peroxydisulphate (10%) and 640 g of aluminium sulphate; the, 450 g of kieselguhr, 150 g of kaolin, 150 g of dicyanodiamide and 450 g of boric acid are added and definitively mixed. The chips treated in that way are subjected to further processing as described above in Example 1.

Example 12:

1200 g of wood chips, 0.2 to 0.6 mm in thickness and 1 to 15 mm in length, with a moisture content of 5%, are mixed with 200 g of diphenylmethane 4,4'-diisocyanate, 400 g of phosphoric acid (60%), 400 g of aluminium sulphate, 200 g of water; a mixture of 400 g of kieselguhr, 150 g of dolomite, 100 g of kaolin and 400 g of boric acid is then added and further mixing is effected.

The treated chips are subjected to further processing as described above in Example 1.

Example 13:

1200 g of wood chips, 0.2 to 0.6 mm in thickness and 1 to 15 mm in length, with a moisture content of 4%, are mixed with 450 g of melamine urea phenol formaldehyde resin (60%), 200 g of water, 370 g of boric acid and 15 g of soda lye (50%); a mixture comprising 300 g of aluminium sulphate, 100 g of kaolin, 250 g of kieselguhr and 120 g of dolomite is then added and further mixing effected. The chips treated in that way are subjected to further processing as described above in Example 1.

CLAIMS

1. A method of manufacturing fireproofed chipboards and wood chip shaped-members, by admixing one or more fireproofing substances, wood chips and adhesive resin, distributing the preglued wood chips and pressing same, wherein the adhesive resin is made strongly acidic with the admixture of one or more fireproofing substances and the preglued wood chips are mixed with one or more fillers which prevent combustion prior to fabrication so that the adhesive resin wood chip mix is at least substantially neutralized by said fillers.

2. A method according to claim 1 wherein the concentration of the adhesive resin and the fireproofing substances is such that, with an initial moisture content of the wood chips of about 4%, the moisture content of the preglued chip mix to which are added the fillers for preventing combustion is about 10 to 25%.

3. A method according to either of claims 1 and 2 wherein phosphoric acid is mixed with the adhesive resin.

4. A method according to claim 3 wherein the phosphoric acid is mixed with the adhesive resin in a weight ratio of 4 : 1 to 1 : 4.

5. A method according to any one of claims 1 to 3 wherein boric acid is mixed with the adhesive resin.

6. A method according to any one of the preceding claims wherein aluminium sulphate is added to the glue ingredient.

7. A method according to any one of the preceding claims wherein a hardener is added to the adhesive resin.

8. A method according to claim 7 wherein the hardener comprises from 2 to 10% of ammonium chloride or ammonium sulphate or diammonium peroxydisulphate in the form of a 10 to 30% aqueous solution.

9. A method according to any one of the preceding claims wherein the combustion-preventing fillers are inorganic substances.

10. A method according to claim 9 wherein the fillers are selected from aluminium oxide hydrate, aluminium sulphate, dolomite, kaolin, kieselguhr, barytes and mixtures of said substances.

11. A method according to anyone of the preceding claims wherein the fillers are admixed in proportions by weight of between 10 and 50%, with respect to the weight of the product.

12. A method according to any one of the preceding claims wherein phosphoric acid and/or boric acid are also added to the preglued wood chips together with the fillers.

13. A method according to any one of the preceding claims wherein the adhesive resin is selected from urea, melamine, melamine urea, melamine urea phenol formaldehyde and isocyanate resins, wherein the amino resins may optionally contain up to 25% of isocyanates.

14. A method according to claim 13 wherein the isocyanate is diphenylmethane-4,4'-diisocyanate.

15. A method according to any one of the

preceding claims wherein the proportion of wood is from 20 to 85%.

16. A method according to claim 15 wherein the preportion of wood is from 20 to 50%.

17. A method according to any one of the preceding claims substantially as herein described.

18. A method for the manufacture of fireproofed chipboard and wood chip shaped-members substantially as herein described in any one of the Examples.

19. Each and every novel method, process, product and composition substantially as herein described.

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